United States
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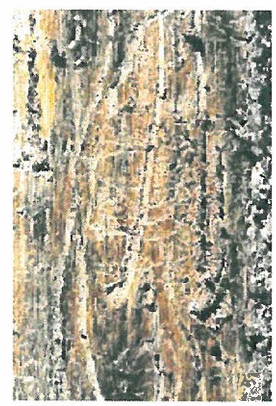
Northern Region

Forest Health
Protection

Forest Insect and Disease Conditions and Program Highlights

1999


Ips Bark Beetle


Mountain Pine Beetle

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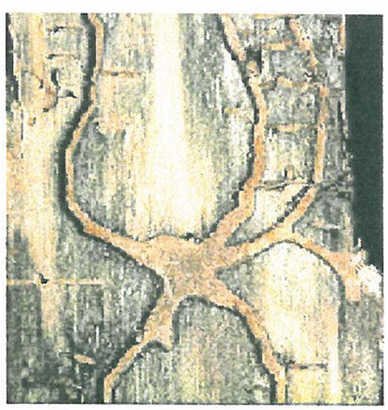
Western Balsam Bark Beetle


Western Pine Beetle

Montana
Department of
Natural Resources
and Conservation

Forestry Division

MONTANA

Forest Insect and Disease Conditions and Program Highlights - 1999

Report 00-2

September 2000

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INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 1999 and was jointly prepared by Forest Health Protection, State and Private Forestry, Northern Region, USDA Forest Service and the Montana Department of National Resource and Conservation, Forestry Division. Information for the report was derived from ground and aerial surveys conducted across much of Montana.

SUMMARY OF CONDITIONS

Douglas-fir beetle made a dramatic increase in western Montana, highest on the Kootenai National Forest. High levels of lodgepole pine mortality from mountain pine beetle continues in the same general areas of western Montana, especially on the Lolo National Forest. A slight increase in scattered white bark pine mortality caused by mountain pine beetle was also observed, primarily on the Gallatin National Forest. Although not all areas of subalpine fir were surveyed in 1999, mortality is still substantially occurring in south central Montana on the Gallatin and Beaverhead National Forests.

No visible defoliation occurred from western spruce budworm or Douglas-fir tussock moth. There was an increase in the acres of larch casebearer defoliation in far western Montana, often difficult to distinguish from the larch needle casts. Scattered infestations of tent caterpillar and satin moth appeared across much of western Montana. No gypsy moths were caught in traps in Montana in 1999.

Needle diseases continued to be heavy in localized areas, indicating favorable weather conditions for infection of the responsible fungi were present in 1998 and 1999. Elytroderma needle blight was heavy in ponderosa pine in localized areas across western Montana. Rhabdocline needle cast was detected in Douglas-fir in large areas across the state, on both sides of the Divide. Localized areas of heavy rust infection in hawthorn were noted in eastern Montana, specifically in Golden Valley, Fergus, and Judith Basin counties. Needle casts in pine in eastern Montana were also heavy in localized areas. A new needle cast to Montana, *Davisomycella ponderosae* (Staley) Dubin (=*Lophodermium ponderosae* Staley), was found on ponderosa pine southeast of Lewistown. Larch needle diseases were again low from the 1997 high levels. Needle blight in limber pine was again high, marking the fifth consecutive year of severe damage.

Mortality and growth losses from root disease and dwarf mistletoes continue to be high throughout the state. Root disease-caused mortality is more common west of the Continental Divide, although large patches can be found east of the Divide. Dwarf mistletoe continues to cause losses of approximately 33 million cubic feet annually. Douglas-fir, western larch and lodgepole pine are the tree species most severely affected. White pine blister rust continues to be present throughout the range of five-needle pines in the state. Rust severity is highest in the northwestern part of the state where the disease continues to cause extensive mortality in western white pine.

ANNUAL AERIAL SURVEY

The annual aerial detection survey in Montana was conducted from July 6 until September 23, 1999. The survey took approximately 280 aircraft flight hours and covered approximately 23,517,000 acres of mixed ownership forest lands, excluding wilderness areas. See Figure 1, Areas of 1999 coverage during the Forest Health Protection Aerial Detection Survey in Montana. The 1999 aerial survey included three Forest Health Protection sketch mappers, each using a different airplane to fly the survey in Montana. Due to a variety of reasons, which included a wet early summer, several days of high winds aloft, warm wet air pumped up from the Gulf and Idaho's Douglas-fir beetle outbreak causing longer flight times in Idaho, not all of the planned flight areas in Montana were flown. Areas not flown include Beaverhead NF, parts of Lewis and Clark NF, portions of Custer NF, Yellowstone National Park and portions of Glacier National Park.

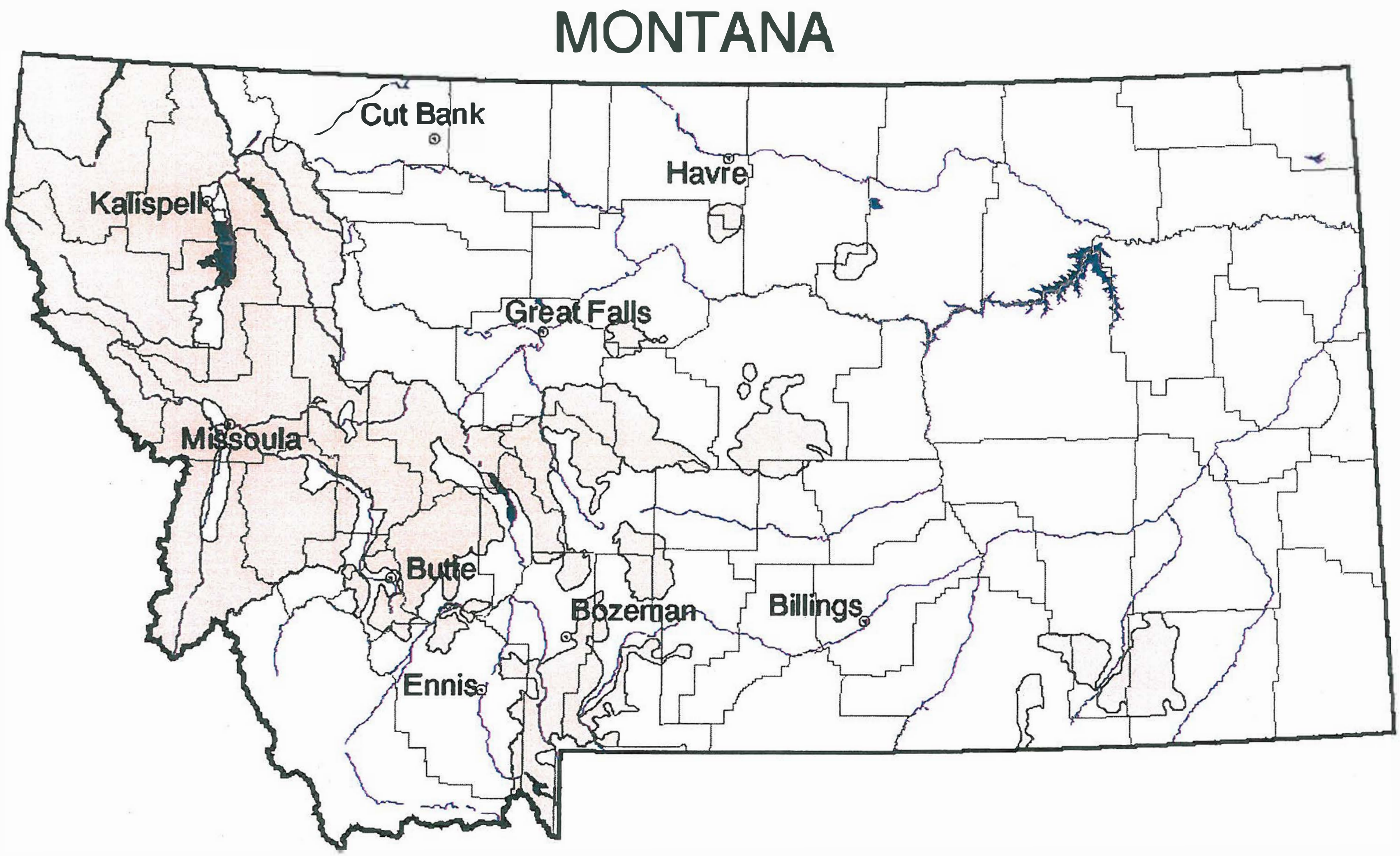
Much of the data summarized in this report is a product of the aerial survey, as well as ground

surveys and biological evaluations. Along with the data summaries, aerial survey maps are available from the Forest Health Protection Field Office in Missoula, in both paper and digitized GIS format.

The annual aerial detection survey is an overview survey designed to cover large areas in relatively short periods of time. Aerially detected signatures include tree mortality, defoliation, and windthrow. Additional signatures that may be detected include needle casting, discoloration, canopy openings, and other damage. Suspected causal agents are recorded. The survey attempts to cover each area once a year during which time the observer sketch maps as many disturbances and damage as possible. The survey is conducted using single-engine, high-wing airplanes, flying at speeds of approximately 90 to 130 M.P.H., at an average altitude of approximately 1,000 to 2,000 feet above ground level. The flight pattern is almost all contour, meaning following drainages, while using one observer in each airplane.

Aerial survey data are estimates made from airplanes and, though not as many areas were ground checked for accuracy, as we would like, enough were checked to lend confidence to the areas for which we have only aerial survey data. Together, aerial and ground surveys provide information relative to bark-beetle-caused mortality, as well as other damage agents, pertinent to land managers charged with the responsibility of maintaining forest health.

FIGURE 1. Aerial Detection Survey



Areas of 1999 coverage during the Forest Health Protection Aerial Detection Survey in Montana.

TABLE 1. Bark beetle infested acres, 1995-1999

	1995	1996	1997	1998	1999
DFB*	5,805	4,353	3,995	8,310	38,259
ESB	767	1,267	1,502	1,995	830
IPS	8,220	19	513	698	214
WPB	1,433	1,181	857	1,318	1,324
FE	349	401	615	523	134
WBBB	41,425	44,673	30,088	59,248	43,472
MPB	31,340	27,503	34,187	39,198	144,000
Total	89,339	79,397	71,757	111,290	228,233

***The following abbreviations will be used throughout this report:**

Beetles	DFB	=	Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins
	ESB	=	Spruce beetle, *D. rufipennis* (Kirby)
	IPS	=	Pine engraver, *Ips pini* (Say)
	MPB	=	Mountain pine beetle, *D. ponderosae* Hopkins
	WPB	=	Western pine beetle, *D. brevicomis* LeConte
	FE	=	Fir engraver, *Scolytus ventralis* LeConte
	WBBB	=	Western balsam bark beetle, *Drycoetes confuses* Swaine
	RTB	=	Red turpentine beetle, *D. valens* LeConte
Hosts:	LPP	=	Lodgepole pine
	PP	=	Ponderosa pine
	WWP	=	Western white pine
	WBP	=	Whitebark pine
	DF	=	Douglas-fir
	GF	=	Grand fir
	SAF	=	Subalpine fir
	ES	=	Engelmann spruce
Other:	NF	=	National Forest
	RD	=	Ranger District
	IR	=	Indian Reservation
	BLM	=	Bureau of Land Management

Reporting area summaries follow. For each, bark beetle effects on their respective hosts are noted. To the extent possible, we have noted areas affected, estimated impacts and population trends. Although reporting areas are designated by Forest names, there are, within those reporting areas, lands under various ownerships—NFS, other Federal, State, and private.

BARK BEETLE CONDITIONS IN BRIEF

Douglas-fir Beetle (DFB)

Earlier than normal fading, and follow-up ground surveys in fall1998, indicated epidemic populations of DFB were present in western Montana. As anticipated, acres on which DFB-killed trees were mapped increased dramatically in 1999. On three western Montana National Forests, (Kootenai, Lolo, and Bitterroot) a total of nearly 30,260 acres contained some level of DFB-caused mortality. On those acres, an estimated 121,600 DF were killed in 1998 (mapped as "faders" in 1999). This was the highest level of mortality and area infested by DFB since a major outbreak in the early 1950s. Unusually high amounts of wind-thrown and storm-damaged material in spring 1997 provided brood sites for dispersing beetles throughout much of northern Idaho and northwestern Montana. Because most was either not detected, or not salvaged, DFB populations increased markedly in both 1997 and 1998. Aerial detection surveys showed that most of the infested acres were in western Montana. Ground surveys conducted this past field season indicated that in much of the infested area, trees attacked and killed in 1999 were fewer than in 1998, although populations throughout western Montana remained abnormally high. With a few exceptions—some areas on the Kootenai and Gallatin NFs showed still building populations—we anticipate an overall declining trend in infested acres over the next couple of years.

The following table shows acres infested by DFB in 1999, compared to those infested in 1998. Where possible, we have indicated the anticipated trend of DFB populations in those selected areas.

Douglas-fir Beetle

FOREST	Acres infested 1998	Acres infested 1999	Anticipated Trend
Kootenai	2,292	19,858	Declining
Flathead	796	4,237	Declining
Lolo	2,332	9,495	Declining
Bitterroot	358	1,163	Declining
TOTAL	5,778	34,753	

Mountain Pine Beetle (MPB)

MPB-infested acres also increased in 1999—to the highest level in more than 10 years. Statewide, total infested area, in all host species, reached an estimated 77,000 acres. Slightly more than 39,000 acres had shown some level of MPB activity in 1998. Infestations remained most severe on the Lolo and Flathead NFs. Because of the extent of susceptible LPP stands existing in western Montana, MPB populations will likely continue to increase for the next several years unless ameliorating actions are implemented.

Most beetle-caused mortality has occurred in LPP stands; however, all native pine species have been affected to some extent. Ground surveys showed some stands have experienced mortality at a rate of 80-100 trees per acre, per year.

The following table shows acres infested by MPB in 1999, compared to those infested in 1998, for the most severely affected Forests in the State. Where data permits, we have indicated the anticipated population trend.

Mountain Pine Beetle

FOREST	Acres infested 1998	Acres infested 1999	Anticipated Trend
Flathead	2,827	4,276	Increasing
Lolo	25,182	49,166	Increasing

Western Balsam Bark Beetle (WBBB)

WBBB is known to be a major factor in the general phenomenon referred to as "SAF decline." In some areas, other agents such as root diseases and some other bark beetles may also be involved. The area in which SAF mortality was mapped increased in 1999 from what had been observed in 1998. Most damage remained on the Gallatin and Beaverhead NFs; however, damage and/or beetle populations increased on several other Forests in the State. Other Forests showed varying levels of infested SAF stands. In total, an estimated 43,400 acres were known to be infested in 1999. The Beaverhead NF was not flown in 1999, but we know many infested stands remained there. Statewide, an average of from 1-2 trees per acre were killed.

Fir Engraver (FE)

FE populations decreased again in 1999 from 1998 levels. About 520 acres had some level of damage associated with FE in 1998. That affected area declined to 130 acres in 1999. As long as moisture levels remain about normal, it is anticipated that infested areas will continue to decline.

Others

Other bark beetle species—pine engraver (IPS), spruce beetle (ESB), western pine beetle (WPB), and red turpentine beetle (RTB)—while observed at varying but noticeable levels from Forest to Forest, remained at low to endemic levels throughout the State.

Table 2, shows a comparison of acres of host type infested by major bark beetle species for the past 3 years. Data were obtained from annual aerial survey estimates, and as such are estimates of extent and amount of bark beetle-related mortality. In most cases, bark beetles are the ultimate mortality-causing agent, but in some situations, other factors—such as diseases, drought, or other damage—may have predisposed trees to bark beetle attack. Rarely can that be detected from the air; therefore, the need for follow-up ground assessments. Many beetle-infested areas have been surveyed on the ground; still most information is based on aerial survey estimates. Time and personnel limits our ability to conduct ground surveys, but such surveys are an integral and necessary part of our effort to assess bark beetle population trends and resultant impacts.

Year-to-year comparisons of infested acres, accompanied by ground-collected data and the following narratives, provide a limited means of assessing population trends and associated future bark beetle-caused mortality. Bark beetle activity, dependent upon available and susceptible hosts, is at least co-dependent upon weather conditions. Adverse conditions that result in abnormal stress on their hosts, favor depredations by bark beetles. The converse is likewise true, as is the ever-present "Law of Biological Reality," which states: "Under any given set of circumstances, organisms behave as they damn well please!"

TABLE 2. Acres of host type infested by bark beetles[1], 1997-1999.
(x 1000)

MONTANA

Host/Beetle	1997	1998	1999
DF/ DFB[2]	4.0	8.3	38.4
ES/ESB	1.5	2.0	0.8
GF/FE	0.6	0.5	0.1
PP/ IPS	0.5	0.6	0.2
PINE[3]/MPB	34.2	39.2	77.6
SAF/WBBB	30.1	59.2	43.5
PP/WPB	0.9	1.3	1.3

[1] Unless confirmed by other data, bark beetles are assumed to be the primary mortality-causing agent by aerial observer.

[2] See Appendix for beetle and host abbreviations used throughout report.

[3] All MPB hosts: LPP, PP, WWP, WBP/ LP

Infestation summaries, by reporting area follow. "Reporting areas" typically are lands administered by a National Forest (NF) and surrounding or associated lands of other ownerships—State, other Federal, and private. For each reporting area, bark beetle status includes areas affected, estimate of impacts and to the extent possible, a prognosis of population trends.

BEAVERHEAD NF

Aerial survey information for the Beaverhead NF was not obtained in 1999; however, flights in 1998 showed extensive areas of SAF mortality. Though ground surveys have shown SAF "decline" is often attributable to a complex of factors, the most common and prominent one in most areas is WBBB. In 1998, SAF stands on more than 18,600 acres were affected to some extent.

Dillon RD—Numerous large groups of dead, probably killed by WBBB, SAF were found north of Lima Reservoir and Red Rock Lakes, and north throughout the Gravelly Range, nearly to Virginia City.

Wise River RD—SAF mortality, attributed to WBBB, was noted in a widely scattered pattern throughout the Pioneer Mountains.

Wisdom RD—Faded, and likely beetle-killed, SAF were mapped west of Wisdom from the Anaconda Range on the north to the Beaverhead Mountains on the south.

BITTERROOT NF

Sula/West Fork RDs—Numerous scattered small groups of from 5-20 trees each, killed by DFB, were observed in the Skalkaho drainage, east of Hamilton. Many groups were also widely scattered throughout the East Fork Bitterroot River drainage, east of Sula. The most numerous and widespread outbreaks of DFB on the Forest—and some of the most intense in the Region—occurred in West Fork Bitterroot River drainage, and west across the Idaho/Montana border into the Selway-Bitterroot and River of No Return Wilderness areas. Outbreaks along Deep Creek, Little Clearwater River and other tributaries of the upper Selway River are numerous and quite extensive. Groups of faders numbering several hundred to several thousand are common. One group, numbering an estimated 10,000 dead trees was observed along Wilkerson Creek, southwest of Hells Half Acre Mountain. It is the largest single group noted in the Region during these current outbreaks. In total, on the West Fork District, nearly 60,000 trees were killed on more than 13,000 acres in 1998 (recorded as faders in 1999). A few small groups of WBBB-killed SAF were also noted in the upper Selway River drainage.

Darby/Stevensville RDs—Numerous, but small and scattered groups of DFB-killed DF, and PP mortality attributed to both MPB and WPB, were mapped within Willow Creek drainage, in the Sapphire Mountains, north and east of Hamilton (Stevensville RD). North from Willow Creek, also scattered throughout the Sapphires, small and widely scattered groups of DF killed by DFB, and PP killed by both WPB and MPB, were mapped. Occasional groups of WBBB-killed SAF were also noted. On the west side of the Bitterroot Valley, in small and very widely scattered groups, virtually endemic populations of DFB killing DF, MPB and WPB infesting PP, and WBBB affecting SAF were noted. Several small groups of DFB-caused mortality were mapped in Lost Horse Creek

drainage, north of Lake Como; and in Tin Cup Creek drainage, west of Darby.

Forest-wide, more than 13,600 acres were infested by DFB, and an estimated 61,000 DF were killed. More than 2,500 PP, on almost 2,000 acres, killed by MPB were also mapped.

CUSTER NF

Ashland RD—Widely scattered, mostly small groups of MPB-affected PP were mapped throughout PP stands on the District. Notable concentrations were observed along Beaver Creek, West Fork Pumpkin Creek, East Fork Otter Creek, and near Cook Mountain. In the southern part of the District, more concentrated groups of PP faders were noted along Stocker Branch of Dell Creek, Cub Creek, Taylor Creek and upper Fifteenmile Creek. Most groups were small, less than 10 trees each, and did not constitute a significant beetle outbreak.

Sioux RD was not flown in 1999.

DEERLODGE NF

Butte and Jefferson RDs—Numerous, but still relatively small and widely scattered groups of MPB-caused mortality in LPP were mapped within a few miles of Butte--to the north, in Hail Columbia Gulch; to the east in Brookside Canyon and near Delmoe Lake; and to the south in Basin and Little Basin Creeks, and near Thompson Park. Other, small fader groups were noted northeast of Boulder. Though populations are small, ground surveys indicate they are building rapidly in several areas where susceptible LPP stands are found. Also widely scattered throughout the reporting area were small groups of DFB-killed DF and SAF killed by WBBB. None were larger than 30-tree groups. Most DFB activity was noted south of Butte in Blacktail Creek and Basin Creek drainages; and in the northern Tobacco Root Mountains in Mill Creek and Beall Creek drainages. SAF mortality was also noted in the Tobacco Root Mountains, along White Ridge, and scattered along the eastern slopes of Fleecer Mountain.

Deerlodge RD—A few groups of beetle-killed trees--LPP affected by both IPS and MPB, and DF infested by DFB--were mapped east of Deer Lodge near Hidden Hand Mine and south towards Black Mountain. West of Deerlodge, in the Flint Creek Range, numerous small groups of DFB-killed DF were mapped near Lone Tree Hill, Jackson Park, and Forest Rose Mine. Also, in that same general area, and southward throughout the Flint Creek Range, SAF killed by WBBB were noted.

Philipsburg RD—Small and scattered groups of DF and LPP killed by bark beetles were observed on western slopes of Flint Creek Range, east of Philipsburg. Notable were groups of MPB-killed LPP in the vicinity of Georgetown Lake and in Boulder Creek drainage. North and west of Philipsburg, in Harvey Creek drainage, many small and widely scattered groups of DFB-killed DF were observed. Elsewhere, DF and SAF killed by DFB and WBBB respectively, were found widely scattered throughout the District.

MPB-killed LPP was found on just over 300 acres, Forestwide, in 1999.

FLATHEAD NF

Swan Lake RD—Many small groups of DFB-killed DF were scattered throughout DF forest types on the District. From Crystal Lake on the south, north to Big Fork, most tributaries of the Swan River contained small (5- to 50-tree) groups of faders. Infrequent small groups of MPB-killed LPP and WWP, or WBBB-killed SAF, and an occasional few ES killed by ESB were noted, but most are insignificant when compared to DFB-caused mortality. In addition, widely scattered groups of DFB-killed DF and SAF killed by WBBB were observed on the "Island Unit," north of Lake Mary Ronan. Other groups of beetle-killed DF were more widely scattered west of there. Small and less significant groups of MPB-killed LPP and PP were seen in that area as well.

Spotted Bear RD—Numerous and widely scattered groups of DFB-killed DF were noted throughout the South Fork Flathead River drainage, south of Bunker Creek and northward into the upper reaches of Spotted Bear River. Many were also noted within the Quintonkon Creek drainage. Heaviest concentrations of DFB-caused mortality in that part of the District were found near Big Salmon Lake and in the Helen Creek drainage. In the latter, a 1,000-

tree group was mapped and several numbered more than 100 faded trees. Elsewhere, DFB groups were small and widely scattered. Near Meadow Creek, MPB populations are building rapidly in susceptible LPP stands. Numerous polygons of MPB-killed trees were mapped from there north to Spotted Bear River. Some groups were as large as 8,000 trees each; several others were estimated at more than 1,000 trees each. Occasional small groups of ESB-killed ES and a few WBBB-killed SAF were also noted at scattered locations on the District.

Hungry Horse RD—Many groups of DF killed by DFB were mapped in a widely scattered pattern on slopes above Hungry Horse Reservoir to the east, and scattered throughout DF stands in the Swan Range to the west. DFB-killed trees were more concentrated in Coram Experimental Forest, near and south of Desert Mountain. A few small groups of ES killed by ESB were also noted in the vicinity of Firefighter Mountain. In addition, many small groups of beetle-killed SAF and fewer ES and DF were mapped above Middle Fork Flathead River, from West Glacier to Nimrod. Across the River, into Glacier NP, widely scattered groups of SAF, DF, and ES were killed by beetles from Lincoln Creek southeastward to Ole Creek.

Glacier View RD—Numerous groups of DFB-killed DF were concentrated in Big Creek drainage, west of its confluence with North Fork Flathead River. Other groups were found to be more scattered throughout tributaries of the North Fork, especially Coal Creek and Red Meadow Creek. Also numerous and widely scattered groups of trees killed by WBBB were mapped in higher elevation SAF stands within the Whitefish Range.

Tally Lake RD—Many groups of DFB-killed DF were widely scattered throughout the District, but were especially numerous in Logan Creek and Griffin Creek drainages, and in stands surrounding Tally Lake and Ashley Lake. Also widely found throughout the District were groups of SAF killed by WBBB. Heavier concentrations of the latter were noted in upper portions of Sheppard Creek, Good Creek, and Martin Creek. A few small groups of MPB-killed LPP and ESB-killed ES were also mapped, but in endemic proportions only.

In the adjacent Stillwater State Forest, to the northeast, widely scattered groups of beetle-killed DF, ES, SAF, and LPP were noted north from Whitefish Lake along the western slopes of the Whitefish Range. Significant amounts of WWP, affected by both white pine blister rust and MPB were also observed in that area.

Forest-wide, in 1999, more than 4,200 acres contained DFB-killed trees totaling an estimated 15,900 trees. On approximately 4,200 acres, MPB killed about 23,000 trees, most of which were LPP.

GALLATIN NF

Bozeman RD—A scattering of small groups of DFB-killed DF were found in tributaries of the Gallatin River, particularly noticeable in Swan Creek and Squaw Creek. The WBBB is the species causing the most impact in forested stands throughout the District. It stretches southward in the Madison Range onto the Hebgen Lake RD. The agent is primarily responsible for vast amounts of SAF mortality in high-elevation stands. Nearly all SAF-dominated stands, from Big Sky Village on the north to Denny Creek south of Hebgen Lake at the southern extreme, have been affected to a greater or lesser degree. There were slightly fewer acres mapped in 1999 than in 1998, but the affected area is still extensive. More than 32,800 acres are still showing some level of beetle-caused mortality. In the Gallatin Range, to the east of Gallatin Canyon, SAF stands are less severely impacted, but widespread mortality was still noted from Yellowstone NP, north to Hyalite Reservoir. Elsewhere on the District, scattered DFB-caused mortality was observed in the Bridger Mountains, north and east of Bozeman. Though less numerous than on Forests in western Montana, DFB-killed fader groups were common in the Bridgers from Battle Ridge, south to Bozeman Pass.

Hebgen Lake RD—DFB-caused mortality was extensive in old-growth DF stands on both the north- and south-facing slopes adjacent to Hebgen Lake. An outbreak in the Watkins Creek drainage was still quite active. Ground surveys conducted there showed numerous

trees attacked and killed in 1999—a significant increase over the number infested in 1998.

Livingston and Gardiner RDs—DFB outbreaks were still active in the Mill Creek drainage, south of Livingston, in the Crazy Mountains north of Livingston, and in tributaries of Bear Creek near Jardine, northeast of Gardiner. Also observed in the Crazy Mountains was extensive mortality in SAF stands, which was attributed to WBBB. Beetle-killed SAF were especially noticeable in Sweet Grass Creek drainage and near Lebo Peak. Infestations extend into northern portions of the Crazy Mountains, on the Lewis and Clark NF.

Big Timber RD—The Boulder River drainage was not flown in 1999, but ground reports of DFB activity in that area are extensive. Follow-up surveys and some trapping are anticipated in 2000.

Tree mortality on the Forest and adjacent lands of other ownerships in 1999 totaled an estimated 47,500 SAF killed on 37,600 acres; and 2,900 DFB-killed DF on approximately 1,200 acres.

HELENA NF

Lincoln RD—While major concentrations of bark beetle activity have not been found on the Forest for a few years, there were noticeable amounts of mortality attributable to DFB on the District in 1999. Significant amounts of DFB-caused mortality were still noted in Arastra Creek drainage, north of Black Mountain and in Moose Creek drainage, south of Highway 200. Elsewhere on the District, and throughout the Forest, DFB-caused mortality is of a more scattered nature.

Helena RD—Notable concentrations of DFB-caused mortality were noted south of Holter Lake and east of the northern end of Canyon Ferry Lake. There were also minor amounts of MPB-caused mortality scattered throughout LPP and PP types at various locations on the District, but particularly noticeable east of Maryville and both southwest and southeast of Helena.

Townsend RD—DFB-killed DF was noted in upper Crow Creek drainage, west of Townsend. LPP and PP killed by MPB were noted throughout host types, but more PP mortality was concentrated east of Holter Lake and in the Dry Range west of Smith River near Blacktail Creek—A few small groups of beetle-killed SAF were observed at higher elevations near Bald Butte and Hogback Mountain.

The most significant damages attributed to bark beetles on the Forest and surrounding lands in 1999 were more than 1,000 DF killed on nearly 600 acres, and more than 1,500 PP killed by MPB on almost 700 acres.

KOOTENAI NF

Cabinet RD—DFB-caused mortality was heavy throughout many of the DF-dominated stands on the District. Stands in the Beaver Creek and Elk Creek drainages were heavily impacted. Elsewhere, many tributaries of the Clark Fork River, from Beaver Creek west to Blue Creek contained DF stands severely impacted by DFB activity. Tree baits and pheromone-baited funnel traps were used in conjunction with salvage opportunities to reduce beetle-caused mortality at some locations on the District.

Libby/Canoe Gulch RDs—DFB-caused mortality was prevalent, but in relatively small groups from Loon Lake northwestward to Fisher River, near its confluence with McKillop Creek. Many other DF-dominated stands on the District were seriously affected by DFB-caused mortality—from Fisher River to the Kootenai River and drainages flowing into the Kootenai River from Libby Dam, westward to the Idaho/Montana border, onto Three Rivers RD. Mapped polygons containing DFB-killed trees were especially numerous north and east of Libby and north of the Kootenai River between Libby and Troy. Some of the largest groups recorded were near Kootenai Falls. To the east, significant amounts of DFB-caused mortality were observed in Wolf Creek drainage. During 1999, several hundred DF stands were surveyed for DFB-caused damage. Only 34 of 176 stands containing beetle-killed trees were found to have 1999 attacks. While some active populations remain, currently infested area appeared to be much less than in 1998.

Three Rivers RD—Unusually high amounts of DFB-caused mortality was also recorded on the northwestern portion of the Forest. From Bull Lake north to Newton Mountain, DFB-killed groups were numerous and observed in many DF stands throughout that area. Group size ranged from 5 to 500 trees. Northward, throughout the upper Yaak River drainage, DFB-caused mortality was lighter and more scattered. Several groups were mapped in the South Fork Yaak River drainage. Also on the District, numerous groups of MPB and blister-rust-affected WWP were noted. Numerous small groups of dead LPP were also attributed to MPB. Elsewhere on the District, scattered groups of WBBB-killed SAF were noted, with several large groups concentrated near Boulder Mountain.

Rexford and Fortine RDs—DFB-caused mortality was prevalent, but less widely occurring than on other districts. Numerous groups were noted on the west side of Koocanusa Reservoir, and others were concentrated in Pinkham Creek drainage (Rexford RD), and Indian Creek (Fortine RD). Also, in upper Pinkham Creek, Sunday Creek, Deep Creek and Grave Creek drainages, SAF mortality attributed to WBBB was prevalent.

Total DFB-caused mortality on the Forest was estimated at nearly 60,000 trees on more than 19,800 acres—slightly more than three trees killed on each infested acre. Other beetle-caused mortality, while present, was much less significant.

LEWIS & CLARK NF

Musselshell RD—In the Crazy Mountains, extensive SAF mortality was caused by a complex of pests, the most obvious being WBBB. Heaviest concentrations were noted in upper portions of Cottonwood Creek drainage, north and east of Virginia Peak. In that same area, undetermined needle diseases in WBP and LP may have attracted significant amounts of secondary bark beetles. Also, in the eastern portion of Little Belt Mountains, MPB-killed PP was recorded in several small groups in Roberts Creek drainage and near Stevens Butte. Noticeable amounts of WBBB-killed SAF were observed in several locations in Little Belt Mountains—North Fork Sawmill Creek, near Lost Fork Ridge, east of Kings Hill, near Tepee Butte, and more scattered near Quartzite Ridge.

Kings Hill RD—A small amount of MPB-killed LPP was noted north of Pioneer Ridge, and somewhat widely scattered throughout the western portion of the Little Belt Range. In the Tenderfoot Creek drainage, several areas of MPB-killed PP were also noted. Though areas extended to several hundred acres each, mortality generally averaged one tree per acre or less. Widely scattered throughout the upper portions of that drainage were beetle-killed SAF, DF and LPP.

Judith RD—To the north, in the Highwood Mountains, widely scattered small groups of MPB-killed LPP and DFB-killed DF were observed. Most groups ranged from 1 to 20 trees in size.

On the eastern portion of the Forest, south of Lewistown, on portions of both Judith and Musselshell RDs, and on BLM-administered land north of Lewistown, in the Judith, South Moccasin and North Moccasin Mountains, MPB-killed PP was seen widely scattered in small groups. Also, in the Judith Mountains, there were minor amounts of LPP killed by MPB. No major beetle outbreaks exist in that area, but there were significant concentrations of MPB-killed PP faders mapped in Willow Creek drainage (Little Snowy Mountains) and North Fork McDonald Creek (Judith Mountains). Some minor amounts of DFB-killed DF were mapped in the Big Snowy Mountains.

Forestwide, MPB killed more than 1,700 PP on 1,550 acres; and another 780 LPP on 570 acres. In addition, almost 4,500 SAF were killed and attributed to WBBB on 2,700 acres.

LOLO NF

Seeley Lake RD—Widely scattered small groups of DFB-killed DF were observed on the west slopes of the Swan Range. Groups were more noticeable south and east of Seeley Lake, less so to the north and west, although a small concentration was mapped west of Placid Lake. MPB-killed LPP and PP were mapped in stands adjacent to Seeley Lake to the south; and LPP killed by MPB were mapped to the north, in

several small tributaries of the Clearwater River. PP mortality was more noticeable south of Salmon Lake and in the vicinity of Ninemile Prairie. Minor amounts of ESB-killed ES and SAF killed by WBBB were found in isolated locations in the Swan Mountains, east of Seeley Lake.

Missoula RD—Numerous but somewhat scattered groups of DFB- and WBBB-killed trees were mapped within the Rattlesnake Wilderness, north and east of Missoula. Heaviest concentrations of DF killed by DFB were noted south of Point Six, near Blue Point, and within the West Fork Gold Creek drainage. A few spots of MPB-killed LPP and MPB-infested WBP were observed in the upper reaches of Rattlesnake Creek. South and east of Missoula, in several tributaries of the Clark Fork River, south of I-90, many groups of DFB-killed DF were noted. Especially heavy concentrations were seen in Rock Creek drainage and its tributaries. Most DFB-killed groups in that part of District were small, approximately 10 to 50 trees each. Several, however, numbered 100 or more. One 500-tree group was mapped in West Fork Schwartz Creek, southwest of Clinton. In the upper portion of Rock Creek, numerous groups of WBBB-killed SAF were observed. To the west, in the Lolo Creek drainage, numerous, but widely scattered groups of LPP killed by MPB and DFB-killed DF were mapped south of Highway 12, west of Lolo. No major outbreaks were recorded in Lolo Creek drainage, but beetle-killed groups were more numerous in the East Fork Lolo Creek, Grave Creek, and Martin Creek drainages. A few WBBB-killed trees were noted in high-elevation SAF stands throughout Lolo Creek and its tributaries.

Ninemile RD—Extremely heavy concentrations of MPB-killed LPP were again recorded in upper Ninemile Creek drainage. Though total infested area is slightly smaller than last year, extremely large polygons of beetle-killed trees were still mapped near Siegel Pass. That outbreak, extending onto Plains/Thompson Falls RD to the west, covered several thousand acres and has killed trees numbering into the hundreds of thousands. One polygon just north of Siegel Pass contained an estimated 20,000 MPB-killed LPP; another north and west of there, 60,000; and others to the south and west numbered 10,000; 10,000; 8,000, and 4,000 respectively. Many smaller groups contained from five to several hundred beetle-killed LPP each. Another smaller outbreak was recorded in the Mill Creek drainage, north of Frenchtown. Elsewhere on the District, MPB-killed LPP and PP were more scattered throughout the Ninemile Creek drainage. Along the Clark Fork River, and in tributaries to the south--especially Fish Creek and its tributaries--many well-distributed, but mostly small groups of DFB-killed trees, were mapped.

Superior RD—East of Superior in the Trout Creek drainage, many groups of DFB-killed DF were noted--many in the vicinity of Gold Mountain Mine. Other significant groups of DF killed by DFB, in both size and number, were noted along the Clark Fork River and its tributaries from Trout Creek to just west of Saltese. The major mortality agent on the District, however, was MPB affecting LPP stands. Extremely heavy outbreaks were mapped from Thompson Creek just west of Superior, to Deer Creek, west of DeBorgia, south of I-90; and from Siegel Pass, west along Keystone Ridge and throughout the Coeur d'Alene Mountains, west to Mount Bushnell north of the Interstate. The outbreak in Sloway Gulch is subsiding, but increasing in the Twelvemile Creek drainage, where polygons numbering up to 80,000 dead trees each were mapped.

Plains/Thompson Falls RD—The devastating outbreak being experienced on Ninemile and Superior RDs has extended to many LPP stands on the District within the past few years. The outbreak in 1999 was mapped from Siegel Pass, and north across the Clark Fork River to Corona Divide, then west throughout much of the susceptible LPP in the Coeur d'Alene Mountains. Heaviest concentrations were mapped near Patricks Knob, and in the Swamp Creek, Cherry Creek, and Camp Creek drainages. Of nearly as much importance are significant DFB outbreaks throughout lower-elevation DF stands on the District. Many small and well-distributed groups of beetle-killed DF were mapped in the Weeksville Creek drainage and throughout much of Thompson Creek drainage, from its confluence with Clark Fork

River north to Lazier Creek and Murr Creek. Additional DFB outbreaks were recorded within Prospect Creek drainage from Clark Fork River to Thompson Pass. Of less importance, but scattered throughout high-elevation SAF stands on the District were found mostly small groups of WBBB-killed trees. Stands salvage logged in combination with the use of DFB tree baits and pheromone-baited funnel traps contributed to efforts to concentrate beetle populations and reduce green-tree mortality.

Though data has not been tallied by district, total beetle-caused mortality on the Lolo NF was estimated at more than 477,500 dead LPP on 47,400 acres (10.1 trees per acre); approximately 33,000 DF killed on 9,500 acres (3.5 trees per acre), and other beetle-related mortality numbering 5,300 trees on an additional 3,800 acres.

GARNETS (BLM/State/Private)

While no major areas of bark beetle infestations were noted, there were many small groups of beetle-killed trees scattered throughout the reporting area. DFB-infested groups were widely scattered, with concentrations of several groups, each numbering from 10 to 30 trees, mapped just east of Bonner, north of Olson Peak, and southeast of Clearwater Junction. Other, numerous groups were found throughout DF type. MPB-killed PP was also widely found in the area, with groups especially noticeable south of Highway 200 from about Bear Creek east to Washoe Creek; and north of I-90, north and east of Jens. A few small groups of beetle-killed SAF were observed at higher elevations, and some LPP stands showed MPB-killed trees in the upper portion of Cottonwood Creek. A few widely scattered small groups of dead PP were attributed to WPB in the eastern portion of the reporting area.

Throughout the reporting area, the most significant amounts of beetle-caused mortality were 2,000 PP killed on 1,300 acres and just over 1,300 DF killed on 400 acres.

CROW IR

In the eastern part of the Reservation (IR)—Wolf Mountains east of Lodge Grass—many small groups of MPB-killed PP were noted in several tributaries of Owl Creek, from Bear Creek north to Corral Creek. Largest groups were mapped in Kid Creek, where polygons estimated to contain up to 120 trees were recorded. Other infestations were noted in Thompson Creek and Youngs Creek, tributaries of Rosebud Creek and Tongue River, respectively. Approximately 2,800 PP, killed by MPB, were mapped on 1,400 acres.

FLATHEAD IR

MPB has once again infested many LPP and PP stands on the Reservation. LPP stands on the southeastern shore of Flathead Lake and along the western border of the Reservation—from Bassoo Peak, south to the Reservation boundary just north of Siegel Pass, have been infested and MPB-killed groups of LPP are numerous. Near Siegel Pass, they were part of a major outbreak on the Lolo NF that extended to many parts of the Ninemile and Plains/Thompson Falls RD. Additional LPP-affected stands were found in the southeastern part of the Reservation, near St. Marys Lake and along the Reservation's southern border. There, MPB has also killed noticeable amounts of PP. PP stands have also been infested by MPB along the northern and eastern borders of the Reservation, especially noticeable near Big Arm. DFB-killed DF was observed in the upper Jocko River drainage and scattered throughout western slopes of the Mission Mountains, south of Flathead Lake.

In total, on the Reservation, 2,700 MPB-killed PP and 8,000 LPP were mapped on 1,100 and 2,000 acres, respectively. Other beetle-caused mortality was less significant.

FORT BELKNAP IR

MPB outbreaks in PP stands were not intense, but were noticeable at several locations on the Reservation. They were especially concentrated near Thornhill Butte, Eagle Child Mountain, Sugar Loaf Butte, Spring Park Butte, and in the Beaver Creek drainage. Lesser amounts of MPB-killed LPP were mapped in small groups both to the north and south of Mission Ridge. Beetles killed approximately 1,600 PP on about 900 acres—and lesser amounts of LPP.

NORTHERN CHEYENNE IR

Numerous, but mostly widely scattered groups of MPB-killed trees and ones also occasionally infested by IPS, were noted in PP stands throughout the Reservation. Most were mapped in the Reservation's western portion, in tributaries of Rosebud Creek. Other concentrations were noted in tributaries of Logging Creek, east of Lame Deer. About 1,500 PP were killed by MPB on 600 acres.

ROCKY BOYS IR

Major bark beetle outbreaks were not recorded on the Reservation in 1999; however, there were scattered beetle-killed trees in some stands. MPB-killed trees, both LPP and PP were noted in the southern portion of the Reservation. A noticeable outbreak in LPP in the Green Creek drainage, totaled about 40 trees on 60 acres. Other groups in PP, generally were smaller and more widely scattered; but totaled 2,100 trees on an accumulated 500 acres. A few DFB-killed DF were also observed in that general area.

GLACIER NATIONAL PARK

Only the southern portion of the Park was flown in 1999. There, small and widely scattered groups of DF and ES killed by DFB and ESB, respectively were mapped from about Lincoln Creek to Ole Creek. Most ESB-caused mortality was concentrated in the Nyack Creek drainage. Other beetle-killed groups, including SAF killed by WBBB, were recorded along tributaries of the Middle Fork Flathead River. While not recorded in 1999, there still existed significant DFB and ESB outbreaks in the northern part of the Park—particularly north of Logging, Quartz, Bowman and Kintla Lakes. Ground surveys conducted near Bowman and Kintla Lakes showed still active DFB populations. In 1998, nearly 1,000 acres had been infested by ESB; another 500 acres by DFB. Those infestations likely still exist at those levels or higher.

TABLE 3. Douglas-fir beetle-infested acres and new dead trees in Montana, all ownerships, from 1996 through 1999

	1996		1997		1998		1999	
Reporting Area	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees
Beaverhead NF	31	60	104	118	95	146	★[2]	★
Bitterroot NF	145	121	102	292	358	800	1,163	4,619
Custer NF	663	456	60	162	27	60	NF	NF
Deerlodge NF	40	69	51	148	319	523	825	1,858
Flathead NF	535	1,353	531	1,264	796	2,093	4,237	15,891
Gallatin NF	737	1,612	212	602	750	1,782	1,234	2,896
Helena NF	322	636	269	649	241	530	584	1,037
Lewis & Clark NF	321	797	390	765	2,284	8,475	19,602	59,537
Lolo NF	29	222	213	310	190	276	373	621
Garnets	922	1,819	1,066	1,942	2,332	6,305	9,495	32,890
Flathead IR	125	325	86	141	257	674	417	1,333
Crow IR	197	118	183	317	152	265	164	547
No. Cheyenne IR	9	11	4	5	★	★	★	★
Glacier NP	64	203	136	362	492	1,726	57	146
Yellowstone NP	★	★	537	1,577	★	★	★	★
Other	13	11	10	9	16	36	108	221
TOTAL	3,971	7,813	3,954	8,663	8,309	23,691	38,259	121,596

[1]MBF = 1,000 board feet
★ = Not flown

TABLE 4. Acres of mountain-pine-beetle-caused mortality on State and private lands in Montana from 1996 through 1999

	1996				1997				1998				1999			
Reporting Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	2	0	0	0	4		0	0	38	2	4	0	★	★	★	★
Bitterroot NF	0	291	0	0	0	1,827	0	0	4	824	0	0	0	882	0	0
Custer NF	4	4	0	0	6	77	0	0	4		0	0	0	33	0	0
Deerlodge NF	25	66	0	0	26	12	0	0	120	115	0	0	47	26	0	0
Flathead NF	104	10	0	139	46	97	0	158	142	41	2	944	57	90	12	13
Gallatin NF	119	13	0	0	517	34	10	0	178	4	10	0	69	6	118	0
Helena NF	39	179	6	0	73	312	12	0	21	225	8	0	119	449	12	0
Kootenai NF	90	34	0	34	72	16	2	51	56	31	0	33	15	117	0	63
Lewis & Clark NF	89	953	7	0	147	3,047	0	0	68	384	0	0	122	827	5	0
Lolo NF	1,302	922	0	14	2,008	1,126	13	19	2,040	1,101	0	0	1,819	368	3	7
Garnets	12	2,029	0	0	22	629	0	0	22	314	0	0	20	1,325	0	0
Crow IR	0	48	0	0	0	4	0	0	NF	NF	★	★	★	664	0	0
Fort Belknap IR	0	17	0	0	0	169	0	0	3	338	0	0	0	113	311	0
No. Cheyenne IR	0	0	2	0	0	4	0	0	NF	NF	★	★	0	4	0	0
Rocky Boy IR	0	60	29	0	142	22	0	0	198	20	★0	0	6	336	0	0
Flathead IR	0	466	0	0	29	124	0	0	53	146	0	0	72	0	0	0
Other	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Total	1,786	5,092	44	187	3,092	7,500	37	230	2,947	3,545	24	977	2,346	5,240	461	83

[1]LPP = Lodgepeole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine
★= Not flown

TABLE 5. Acres of mountain-pine-beetle-caused mortality on Federal ownership in Montana from 1996 through 1999

	1996				1997				1998				1999			
Reporting Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	46	0	12	0	125	4	10	0	486	4	31	0	★	★	★	★
Bitterroot NF	48	340	0	0	18	463	0	0	63	358	2	0	34	978	10	0
Custer NF	1	0	6	0	60	447	9	0	0	0	0	0	0	416	0	0
Deerlodge NF	137	82	8	0	86	14	6	0	350	66	4	0	203	31	6	0
Flathead NF	965	6	31	224	793	24	26	213	1,461	8	32	242	3,936	75	28	64
Gallatin NF	134	0	99	0	304	24	85	0	119	0	314	0	133	0	7,684	0
Helena NF	126	216	25	0	144	160	54	0	78	307	30	0	294	232	30	0
Kootenai NF	372	53	2	38	663	42	4	429	1,087	74	4	506	83	252	4	834
Lewis & Clark NF	558	585	11	0	443	1,047	6	0	259	526	4	0	451	724	571	0
Lolo NF	11,629	1,487	7	178	12,766	1,525	34	219	20,087	1,139	8	88	45,558	1,234	61	102
Crow IR	2	101	0	0	6	8	0	0	★	★	★	★	0	732	0	0
Fort Belknap IR	86	1,045	0	0	107	1,129	0	0	98	1,861	0	0	60	753	0	0
Flathead IR	507	323	0	0	693	306	0	0	1,011	144	0	0	2,005	825	2	0
No. Cheyenne IR	0	0	0	0		587	0	0	★	★	★	★	0	582	0	0
Rocky Boy IR	58	46	0	0	60	60	0	0	132	88	0	0	30	174	0	0
BLM (Garnets)	32	28	0	0	6	47	2	0	8	27	0	0	10	16	0	0
Glacier NP	24	0	0	60	14	0	0	16	6	0	0	47	0	0	0	0
Yellowstone NP	★	★	★	★	20	0	22	0	★	★	★	★	0	0	0	0
Total	14,725	4,312	201	500	16,308	5,887	258	877	25,245	4,60	429	883	52,797	7,024	8,396	1000

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = Whitebark pine; WWP = western white pine
★ = Not flown

TABLE 6. Bark-beetle-infested acres (other than mountain pine beetle and Douglas-fir beetle) in Montana, all ownerships

	Engelmann Spruce Beetle				Pine Engraver Beetle				Western Pine Beetle				Fir Engraver Beetle				Western Balsam Bark Beetle			
Reporting Area	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999	1996	1997	1998	1999
Beaverhead NF	2	14	0	*	0	156	382	*	0	118	0	*	0	0	0	*	18,359	6,081'	18,612	*
Bitterroot NF	6	6	16	12	0	0	2	6	199	0	172	134	0	0	4	0	30	12	59	119
Custer NF	324	0	0	0	0	33	0	12	0	0	0	0	0	0	0	0	472	434	37	0
Deerlodge NF	0	3	2	2	0	0	134	74	25	8	28	0	0	0	4	0	93	61	99	291
Flathead NF	278	537	878	304	0	2	0	0	73	38	72	43	123	92	111	79	826	765	760	0
Gallatin NF	396	299	2	244	0	60	0	0	0	0	0	0	0	0	0	0	24,233	21,251	38,806	37,588
Helena NF	14	8	4	22	0	0	2	2	0	106	0	2	0	0	0	0	143	111	65	89
Kootenai NF	4	115	59	82	0	0	4	14	128	91	224	103	29	289	120	6	50	123	287	718
Lewis & Clark NF	8	2	2	45	0	32	36	0	0	0	0	0	0	0	0	0	282	430	241	2,671
Lolo NF	129	38	34	40	0	157	22	22	529	314	432	893	215	215	253	31	133	161	168	1,019
Garnets	0	0	2	0	0	0	3	0	0	45	58	91	0	0	0	2	4	12	2	26
Flathead IR	2	2	4	0	0	6	113	8	159	136	161	59	31	18	26	16	16	13	99	38
No. Cheyenne IR	0	0	*	4	0	65	*	74	0	0	*	0	0	0	*	0	0	0	*	0
Fort Belknap IR	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky Boy IR	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crow IR	0	0	*	0	10	0	*	0	0	0	*	0	0	0	*	0	35	0	*	0
Glacier NP	103	342	991	37	0	0	0	0	2	2	0	0	2	2	0	0	6	0	14	8
Yellowstone NP	*	136	*	0	0	0	*	0	*	0	*	0	0	0	*	0	*	634	*	0
Total	1,266	1,502	1,994	792	12	513	698	212	1,115	858	1,147	1,325	400	614	518	134	44,682	30,088	59,249	42,567

' = Only a portion of the Beaverhead NF was flown in 1997
* = Not flown

FIGURE 2. Douglas-fir beetle

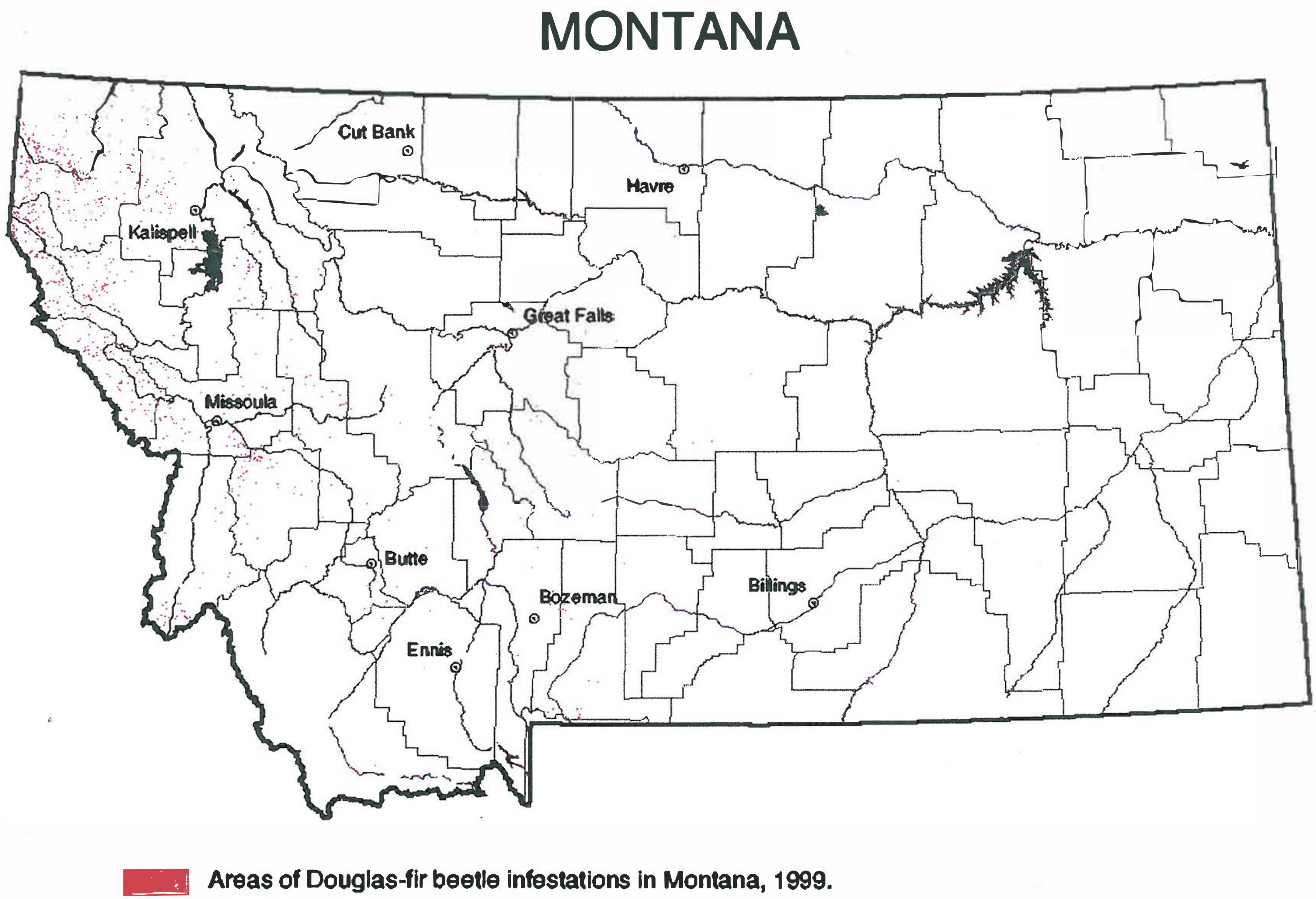


FIGURE 3. Mountain pine beetle

Areas of mountain pine beetle infestations in Montana (all host species) 1999.

DEFOLIATORS

Douglas-fir Tussock Moth

Douglas-fir tussock moth populations, confirmed by trap catches, doubled in 1999 in northern Idaho, but are still at relatively low levels across most of Montana. No aerially visible defoliation was detected; however, larvae were found at most sites sampled in northern Idaho. The Montana trap catch, from 33 sites, (165 traps), totaled 371 moths in 1999, up from 17 in 1998. At Pistol Creek, near St. Ignatius, Montana, 318 moths were found at one site, for an average of 63.6 per trap. A cocoon/egg mass survey was done at the Pistol Creek site, but none were found. A spring larval sampling is planned for this site in 2000. Some minor defoliation was observed on ornamental trees in residential areas, but none was noted in forest stands. This trend may be part of a larger population outbreak pattern/cycle that is occurring in other parts of the Northwest.

Site locations where moths were caught and the number of moths were: Pistol Creek (318), Jette Lake (10), Arlee (8), Blue Mountain (6), Petty Creek (4), Revais Creek (4), Big Creek-Polson (3), Corral Creek (3), Frenchtown (3), Albert Creek (2), Clear Creek (2), Butler Creek (2), Kerr Dam (2), and Lost Lake-Polson (1).

Larch Casebearer

In 1999, visible defoliation caused by larch casebearer (LCB) increased significantly in many western larch stands in western Montana. Though a few areas in which defoliation had been recorded in 1998 decreased in intensity, in other areas, defoliation was recorded for the first time. One of the areas of new, and severe defoliation was along the Bull River Highway between US Highways 2 and 200.

Heavy defoliation was recorded during aerial surveys in several areas. In others, increasing defoliation was noted through ground observations. Most noticeably affected areas in western Montana were on the Kootenai and Lolo NFs (3,500 acres and 3,400 acres, respectively).

Ground collections of LCB pupae made during 1997, 1998 and 1999 showed low parasitism rates in LCB populations, compared to similar surveys conducted during the 1970s—the last time populations were unusually high. Parasitism levels were generally less than 15-20 percent in the past three years compared with rates of 40-65 percent—rates common in the early 1980s when LCB populations began to decline.

Spring larval surveys indicated that some areas will again experience moderate to heavy defoliation in 2000. Monitoring of population levels and parasitism rates will continue.

Satin Moth

By spring of 1999, moth populations in most of the known satin moth infestation areas had collapsed. No noticeable defoliation could be detected in 1999 in any of the areas, including Opportunity, Warm Springs, Galen, Racetrack and other localities in Granite and Ravalli Counties, where many willows and cottonwoods had been severely defoliated in 1998.

European Gypsy Moth

Over 1,600 gypsy moth detection traps were placed by USDA Forest Service, Animal and Plant Health Inspection Service (APHIS), Montana Department of Agriculture, and the Montana Department of Natural Resources and Conservation in 1999. No moths were detected in Montana in 1999. This is the third year of no catches for Montana.

Neighboring states to the south and east did have positive moth catches in 1999. In North Dakota two moths were captured, one in Bismarck and the other at Devil's Lake. In South Dakota four moths were captured in the Black Hills, close to the Montana border, and a fifth moth was caught in the eastern half of South Dakota. Wyoming had six moths trapped at various locations. These catches in neighboring states indicate that in spite of 3 gypsy-moth-free years, continued detection surveys are necessary.

Western Spruce Budworm

Defoliation from western spruce budworm on permanent plots increased in 1999 on the Deerlodge NF in Montana. No budworm defoliation was observed from the air anywhere in the State. Pheromone trap counts were up significantly in some areas in 1999, but remained the same or decreased in others. Trap catches on permanent plots on the Helena

NF and Lubrecht Experimental Station increased to 107 moths in 1999, up from 58 moths in 1998. Populations appear to be rebuilding slowly, but remain low. Increased defoliation may be expected in a few scattered areas where trap counts were above four or five moths per trap in 1999, such as the Deerlodge and Helena NFs. Large population increases are weather dependent and will likely take several more years. A major population increase is not expected in 2000.

DISEASES

Root Diseases

Root diseases are the most significant disease agents of mortality and growth loss in Montana, mostly west of the Continental Divide. Because root diseases are diseases of the site, we see very little changes occurring from one year to the next. The most significant root diseases in Montana are Armillaria root disease (*Armillaria ostoyae* (Romagn.) Herink), laminated root disease (*Phellinus weirii* (Murr.) Gilb.), annosum root disease (*Heterobasidion annosum* (Fr.) Bref.), and brown cubical root and butt decay (*Phaeolus schweintizii* (Fr.) Pat.). The most susceptible tree species in Montana is Douglas-fir, with grand and subalpine firs taking a close second. The most resistant species are western larch, pines and western redcedar, with the remaining species falling somewhere along the gradient between susceptible and tolerant. Although root diseases cause significant amounts of mortality and growth loss, they are also a major agent influencing both structure and species composition across landscapes. Root diseases have greatly influenced succession of vegetation in our forests. This is especially evident in the absence of natural fire.

On sites where there is a mixed species component with root-disease-tolerant species, root diseases tend to prolong the seral stage on those sites. Root diseases slowly thin out the more root disease-susceptible species (Douglas-fir and true firs), and favor the root-disease-tolerant species.

On grand fir/subalpine fir climax habitats, with a Douglas-fir forest type, low levels of root disease will actually push the stand toward climax faster than in the absence of root disease. This is due to the greater susceptibility of Douglas-fir to root diseases. Although grand fir and subalpine fir are fairly susceptible to root diseases, they are measurably more tolerant than Douglas-fir. Root disease on western redcedar/western hemlock climax sites will also push stands toward climax by weeding out the more root-disease-susceptible species on these sites (Douglas-fir and grand fir).

On sites with a root–disease-susceptible forest type and climax habitat, very high levels of root disease will maintain an early stand development. Root disease patches experience wave after wave of mortality as trees become large enough for their root systems to contact the inoculum on the site. Trees are unable to grow to a very large size before being killed by root disease.

The current Douglas-fir bark beetle outbreak in Montana has raised some issues regarding management for Douglas-fir bark beetle (DFB) in root-diseased areas, especially on the Kootenai NF (See FHP Trip Reports TR-99-14, 99-1, 99-26, 99-27). Douglas-fir infected with root disease often harbor endemic levels of DFB which likely aids in the rise of the DFB populations during an outbreak.

Annosum root disease of ponderosa pine is less evident than the above root diseases, but very important in local areas. Informal surveys for this disease have occurred in 1998 and 1999. It has been found causing mortality in ponderosa pine plantations in various locations on the Darby RD, Bitterroot NF (See FHP Trip Reports TR-99-24), private lands west of Kalispell, and continues to be a significant agent on the Flathead Indian Reservation. More surveys are planned for 2000.

DWARF MISTLETOES

Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants that extract water and nutrients from living conifer trees. The dwarf mistletoes are native components of western coniferous forests, having co-evolved with their hosts for millions of years. The different dwarf mistletoes are generally host specific. In Montana, lodgepole pine and larch dwarf mistletoes occur throughout the range of their respective hosts while Douglas-fir mistletoe is only in the range of its host west of the Continental Divide.

Because dwarf mistletoes are obligate parasites, ecological forces that have patterned the development of the host tree species have also played roles in influencing the distribution of dwarf mistletoes across the landscape. Fire is one of those influential ecological forces. In general, any fire event that kills host trees will reduce the population of dwarf mistletoes, at least in the short term. The larger and more continuous the fire disturbance, the greater the reduction in dwarf mistletoe populations at the landscape level. Large, complete burns will greatly reduce dwarf mistletoe populations across the landscape and may even eliminate small, localized populations. Small, "patchy" burns will temporarily reduce portions of dwarf mistletoe populations, but infected residuals provide a ready source of dwarf mistletoe seeds for the infection of the newly developing regeneration.

Human influences, including fire suppression and logging, have also had effects on dwarf mistletoe population dynamics. Partial cutting, which created multi-storied stands, and fire suppression may have served to increase the severity of dwarf mistletoes relative to the "pre-settlement" condition. Conversely, dwarf mistletoes may have been reduced in certain age classes, habitat types, elevation zones or topographic positions that have been intensively managed. Fire suppression and cutting practices that have encouraged shifts in species compositions could have either increased or decreased the disease severity depending on what species of trees and dwarf mistletoes occurred on any given site.

The parasitic activity of dwarf mistletoes causes reduced tree diameter and height growth, decreased cone and seed production, direct tree mortality, or predisposition to other pathogens and insects. It has been estimated that in Montana, lodgepole pine causes an average growth loss of 10.5 ft^3/acre/year and larch and Douglas-fir dwarf mistletoes cause average growth losses of 20ft^3/acre/year in areas where they occur. On the other hand, witches' brooms and tree mortality may result in greater structural diversity and increased animal habitat. Dwarf mistletoe flowers, shoots and fruit are food for insects, birds and mammals. Witches' brooms may be used for hiding, thermal cover, and nesting sites by birds and other mammals. In the long term, heavily infested stands of the host trees can begin to decline, resulting in a successional shift toward other tree species.

HEARTWOOD STEM DECAYS

The main function of heartwood in live trees is to give individual trees vertical stability. The decay of heartwood weakens this vertical stability making trees more susceptible to stem breakage. Stem breakage can lead to mortality and subsequent formation of small-scale canopy gaps. The main successional functions of heartwood stem decays are to move stands from a mature closed canopy to a more open canopy and to perpetuate such an open canopy.

Stem decays are important in the creation of wildlife habitat in living trees. Although primary cavity nesters are capable of excavating in sound wood, they selectively excavate in trees and snags with heartwood decay. Most primary cavity nesters do not reuse their holes from one year to the next. Their previous year's holes are then used by a multitude of secondary cavity nesters, which are very dependent on already-created holes for successful reproduction. Thus, cavity-nesting habitat (i.e., heartwood decay) is necessary for the successful reproduction of a number of animal species.

Heartwood decay fungi are also necessary for the formation of hollow trees, which are also important habitat for a number of animal species. Hollow trees are created when decay fungi invade the heartwood of a living tree. The decay may progress to the point that the cylinder of decayed heartwood eventually detaches from the sapwood and slumps down, leaving a hollow chamber. The only way to obtain a hollow dead tree or log is to start with a living tree hollowed out by decay.

There has been very little work done on determining what fungal species are important in creating cavity-nesting habitat in live ponderosa pine trees. In 1999, FHP investigated some live ponderosa pine trees with cavities on the Bitterroot National Forest (see FHP Trip Report TR-23). A climber was hired to collect increment cores near the cavities. Fungi have been successfully isolated from these increment cores and are presently being identified. A report of the findings should

be available this spring (contact Blakey Lockman).

FHP assisted several wildlife biologists in developing a snag model to better determine how many recruitment trees are needed to have a viable population of future snags in the various ecosystems. Within this model, it was deemed necessary to include a stem decay factor; if it can be assumed that a certain number of live trees will have heartwood decay, then fewer, more suitable trees may be necessary for snag recruitment. The Forest Service queried data across National Forests for the presence of stem decay in the four major tree species most important to cavity-nesting wildlife: western larch, Douglas-fir, ponderosa pine, and western red cedar. The results in brief are contained in Table 7. A short report on the query and the detailed results should be available this spring (contact Blakey Lockman).

TABLE 7. Percent decay by forest and tree species for trees greater than 20 inches diameter at breast height (d.b.h.).[1]

R1 FOREST	% DECAY WL[2] (trees >20" d.b.h.)	% DECAY DF (trees >20" d.b.h.)	% DECAY PP (trees >20" d.b.h.)	% DECAY WRC (trees >20" d.b.h.)
Beaverhead		9.1		
Bitterroot	20.8	12	7	
IPNF	14.8	7.4	6.1	32.9
Clearwater	21.8	14.3	10.8	51.9
Custer		10.4	9.2	
Deerlodge		13.2	10.3	
Flathead	15.8	12.4	7.5	37
Gallatin		8.6	2.7	
Helena	30.8	14.6	9.2	
Kootenai	18.2	14.9	7.5	54.6
Lewis/Clark		14.8	10.3	
Lolo	9	7.8	4.3	30
Nez Perce	18.9	11.4	9.5	38.5

[1] Source is from R1 Edit data from each respective forest.
[2] WL=western larch; DF=Douglas-fir; PP=ponderosa pine; WRC=western red cedar

FHP was involved with another wildlife/stem decay project on the Bitterroot NF. In November 1994, 89 trees were inoculated with stem decays for creation of cavity-nesting habitat. In 1999, some of these trees were destructively sampled to verify the presence of the decay fungi. Preliminary results indicate that all the stem decay inoculations were successful, but the decay was progressing slower than hoped. Tentative recommendations are to inoculate trees with multiple inoculations in order to increase the rate of decay (contact Blakey Lockman).

FOLIAGE DISEASES

Most fungi causing foliage diseases are confined to the needles and leaves; a few attack buds and some also invade young twigs. Foliage diseases are generally more severe in the lower canopy on seedlings, saplings, and

small poles than on larger trees. Most of the fungi affect either foliage of the current season or older foliage, but rarely both; it is unusual for all the foliage in either category to be involved. The fungi vary in occurrence from year to year according to climatic conditions; heavy infection over a period of years is exceptional. Some trees in a stand are severely infected, while others escape with little or no infection, apparently because of individual resistance. Foliage diseases rarely cause mortality, but they do cause a reduction in growth.

Elytroderma needle blight

Elytroderma needle blight (*Elytroderma deformans* (Weir) Darker) is the most damaging foliage disease on ponderosa pine in Montana. The fungus infects and kills needles, but it also invades twigs and causes localized brooms. Spores of the fungus mature in late summer and fall and are dispersed when the needles are wet. The fungus can live from year to year in invaded bark, so the disease can be perpetuated without conditions favorable for either spore production or infection of new needles.

Localized areas of heavy infection from Elytroderma needle blight were seen across western Montana in 1999. Aerial detection surveys documented over 1,200 acres of infected pine, mostly on private land. Elytroderma has been heavy in several areas of western Montana for a number of years (Jette Lake area north of Polson and Bitterroot Valley south of Missoula), but several new heavily infected areas were reported in 1998 and 1999 (Rock Creek drainage east of Missoula). This apparent increase in Elytroderma indicates that favorable weather conditions for infection must have occurred during the summers of 1997 and 1998.

An unusual case of Elytroderma was noted on the Bitterroot NF (TR-99-24). Numerous ponderosa pine plantations in the Lick Creek area on the Darby RD were displaying peculiar symptoms—twisting and deformed stems, trees with severe bending as from snow damage, and outright mortality. After examination, we concluded that the trees were suffering from Elytroderma infection of the stems. Young trees bear needles directly on the stems, and Elytroderma apparently infected the stems directly through those needles, rather than through needles on branches. Elytroderma causes necrotic areas in the cambium that leads to malformed growth patterns. This was the first time we had seen damage like this from Elytroderma.

Rhabdocline needle cast of Douglas-fir

During the early summer of 1999, it was noted in a few areas on the east Kootenai NF that older/larger Douglas-fir had experienced needle casting not previously noted in 1998. It appeared that the rather heavy Rhabdocline (*Rhabdocline* pseudotsugae Syd.) infection in 1998, followed by a summer of very favorable environmental conditions for fungus development, allowed the fungus to mature very early and cause needles to be cast in late winter or early spring rather than the following summer.

A single attack from *Rhabdocline* usually results in only partial defoliation. Trees subjected to several consecutive years of attack may be completely defoliated and killed or severely restricted in growth. The greatest damage is to Christmas trees; even partial defoliation makes them unsalable for a few years. Spores are produced on needles infected the previous year, and infect the current year's needles in May or June. Symptoms develop in early winter, the fungus matures early next spring, sporulates, and needles are cast during the following summer.

Rust of Hawthorn in Eastern Montana

Gymnosporangium rust was observed in hawthorn (*Crataegus douglasii*) over a widespread area in Golden Valley, Fergus, and Judith Basin counties in eastern Montana. Roadside surveys found nearly 100 percent infection of hawthorn bushes within affected areas. Laboratory examinations revealed that two species of *Gymnosporangium* were infecting the hawthorn; *G. clavipes* (Cook & Peck) Cook & Peck.on stems and branches, and *G. bethelii* Kern on leaves and fruit. The stem and branch infections resulted in elongated swellings and a minor amount of branch dieback was apparent. The leaf infections resulted in premature coloration and defoliation. From a distance, the disease was very eye catching because large areas of hawthorn turned bright red in mid-August. The high disease severity observed in 1999

indicates that weather conditions in late spring and early summer were conducive for rust infection to occur. An occasional outbreak of rust will have little effect on long-term health of hawthorn or juniper; however, subsequent years of severe defoliation and twig infection may result in decreased fruit production and branch dieback.

New Needle Cast Found in Ponderosa Pine in Eastern Montana

In late June 1999, Steve Kohler, Forest Pest Specialist with the Montana Department of Natural Resources and Conservation, observed a needle cast in ponderosa pine southeast of Lewistown along the Red Hill Road and along the North and South Forks of Flat Willow Creek in Fergus County. On affected trees, 1-year-old needles were browning from the tips and 2-year-old needles were completely faded to a straw-brown color. Damage was greatest in small trees and in lower crowns of larger trees. Long, linear fruiting bodies were visible on the faded 2-year-old needles. Laboratory examinations by FHP pathologists determined the causal agent to be *Davisomycella ponderosae* (Staley) Dubin (= *Lophodermium ponderosae* Staley). We believe this is the first report of this fungus in Montana. The disease was visually striking in June and July 1999, but by August, many of the affected needles had been shed, and the trees appeared green and "healthy" from a distance. Symptoms observed on the 1-year-old needles indicate that those needles will turn brown by June 2000 and subsequent defoliation will occur. Whether or not infection and defoliation will occur in future summers depends on the occurrence of climatic conditions conducive for infection. An occasional outbreak will have little effect on the long-term health of trees, but several successive years of severe defoliation may result in growth loss or mortality, especially in small trees and/or those growing on extremely dry sites.

NURSERY TREE IMPROVEMENT DISEASES

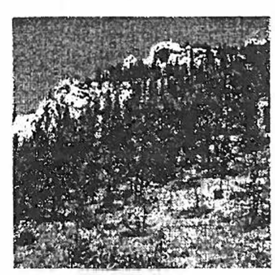
The most important diseases of conifer seedling nursery stock in Montana are caused by *Fusarium* spp.; *F. oxysporum* and *F. proliferatum* are the most important disease-causing *Fusarium* species in bareroot and container nurseries, respectively. Both pathogens cause damping-off of young germinants and root diseases of older seedlings. Other important root pathogens include *Cylindrocarpon* spp. (especially on container-grown western white pine), *Pythium* spp., *Phytophthora* spp., and sometimes *Rhizoctonia* solani. *Botrytis cinerea* is an important foliar pathogen of most conifer species; western larch and Engelmann spruce are especially susceptible. Other important pathogens of conifer seedlings include *Sphaeropsis sapinea, Sirococcus strobilinus* and *Phoma eupyrena*, all causing tip dieback diseases, especially on *Pinus* spp.

Recently, efforts have been underway to develop alternatives to pre-plant soil fumigation with methyl bromide/chloropicrin for production of bareroot seedlings. An alternative soil fumigant (dazomet) has proven effective in a large north Idaho nursery; however, this fumigant has not been effective in a different nursery in southern Idaho. Bare fallowing with periodic soil cultivation for at least 1 year prior to sowing has been as effective as chemical soil fumigation at some nurseries. However, at other nurseries, fallowing by itself has not been satisfactory. Supplementing fallowing with additions of biological control agents and soil solarization (under a polyethylene tarp) is currently being evaluated. Incorporating *Brassica* green manure crops may be effective in reducing levels of soil-borne pathogens; new *Brassica* cultivars are currently being evaluated for use in forest seedling nurseries.

The most important diseases impacting tree improvement plantations in Montana are foliage diseases caused by *Lophodermella concolor* (lodgepole pine), *Meria laricis* (western larch) and *Rhabdocline pseudotsugae* and *Phaeocryptopus gaumannii* (Douglas-fir). When foliage diseases are extensive, tree growth is adversely affected and important selective genetic traits may be masked. Therefore, direct control with chemical pesticides is often required during periods of disease outbreaks.

DECLINES

Limber Pine Decline



Limber pine mortality is continuing across scattered locations in

central and eastern Montana. Permanent plots were established at various locations near Stanford, Monarch, Clyde Park, and Dewey. Data from these plots indicate that mortality is strongly associated with severe defoliation from *Dothistroma* needle blight (*Dothistroma septospora* (Dorog.) Morelet). Defoliation from *Dothistroma* was severe at all plot locations again in 1999, marking the fifth consecutive year of severe damage. Continued mortality is expected. Other factors thought to be contributing to the limber pine decline are winter damage, drought, competition related stress, and additional defoliation from another needle pathogen, *Lophodermella arcuata* (Darker) Darker.

HAZARD TREE MANAGEMENT IN RECREATION SITES

FHP has increased its efforts to provide technical assistance to land managers in the area of hazard trees in recreation sites. Specifically, we provide assistance in the form of site evaluations and on-site training. In 1999, we provided training to personnel on the Idaho Panhandle, Clearwater, and Nez Perce National Forests and did site evaluations of many campgrounds in Glacier National Park. A new form has been developed which aids in the evaluation of hazard trees and assures proper documentation of the evaluation process. Anyone requesting assistance in hazard tree management should contact Jane Taylor or John Schwandt.

SPECIAL PROJECTS

Evaluating the Use of Pheromones for Monitoring Establishment of Agapeta zoegana, a Biological Control Agent of Spotted Knapweed

Although there are many examples of pheromone applications to monitor or regulate populations of insects considered pests, little work has been done on use of phermones to monitor population numbers or trends of beneficial insects such as *Agapeta zoegana* Haw., a biological control agent of spotted knapweed, *Centaurea maculosa* Lam. *A. zoegana* is a root-boring insect that has been propogated and released for spotted knapweed control across Montana over the past 15 years. This study evaluated the attractiveness of *A. zoegana* to four pheromone formulations in 1998, and in 1999, evaluated the most attractive pheromone formulation and compared effectiveness of pheromone trapping to larval and adult visual sampling. There were significant differences (p=0.05) between both Z11-14Ac formulations and the control. Traps baited with Z11-14Ac plus Z11:14OH caught significantly fewer moths than traps baited with Z11:14Ac alone, suggesting the Z11:14OH may have an inhibitory effect on male attraction. In 1999, the higher strength (2.5ug)/trap attracted significantly more (p=0.05) male moths than the lower concentration (0.5ug)/trap or the control. There was a strong relationship between 1999 trap catches and relative abundance of adult moths (r=0.75). An even higher correlation between larvae found in 1998 and 1999 (r=0.90) was identified. This study identified an attractive pheromone formulation for trapping *A. zoegana*, and appears to be an effective monitoring tool for assessing populations without capturing large numbers of males to adversely impact the population. For more information contact Nancy Sturdevant.

APPENDIX

FOREST HEALTH PROTECTION PERSONNEL

Regional Office

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Name	*Position*	*Extension*
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Missoula Field Office

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Gregg DeNitto	Group Leader	3637
Nancy Sturdevant	Entomologist	3281
Ken Gibson	Entomologist	3278
Blakey Lockman	Plant Pathologist	3180
Larry Stipe	Entomologist, GIS Coordinator	3280
Tim McConnell	Bio. Science Technician, Aerial Survey	3136
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Sandy Kegley	Entomologist	7355
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State Forest Pest Management Personnel

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Don Artley	State Forester	
Chris Tootell	Chief, Service Forestry Bureau	4303
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COMMON AND SCIENTIFIC NAMES

Diseases

Annosum root disease	*Heterobasidion annosum* (FR.) Bref.	Primary hosts: DF, GF, PP, SAF
Armillaria root disease	*Armillaria ostoyae* (Romagn.) *Herink*	DF, GF, SAF, sapling pines
Atropellis canker	*Atropellis piniphila* (Weir) Lohn. and Cash	LPP
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.) Pat..	DF
Comandra rust	*Cronartium comandra* Peck.	LPP,PP
Diplodia blight	*Sphaeropsis sapinea* (Fr.) Dyko.	PP
Dutch elm disease	*Ophiostoma ulmi* (Buism.) Nannf.	American elm
Dwarf mistletoes	*Arceuthobium* spp.	LPLP, DF, WL
Brown Stringy rot	*Echinodontium tinctorium*	G, WH
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker	PP
Fusarium root rot	*Fusarium oxysporum* Schlect.	DF (Nursery)
Grey mold	*Botrytis cinerea* Pers. Ex Fr.	WL (Nursery)
Larch needle blight	*Hypodermella laricis* Tub.	WL
Larch needle cast	*Meria laricis* Vuill.	WL
Laminated root rot	*Phellinus weirii* (Murr.) Gilb.	DF, GF, WH, SAF
Lodgepole pine needle cast	*Lophodermella concolor* (Dear.) Dark	LPP
Pini rot	*Phellinus pini* (Thore:Fr.) Pilet.	DF, WL, ES, All pines
Sirococcus tip blight	*Sirococcus strobilinus* Preuss	WWP (Nursery)
Swiss needle cast	*Phaeocryptopus gaeumannii* (Rhode) Petrak	DF
Western gall rust	*Endocronartium harknessii* (Moore) Hirta.	LPP, PP
White pine blister rust	*Cronartium ribicola* Fisch.	WWP, WBP
Rhabdocline needle cast	*Rhabdocline pseudotsugae* Syd.	DF

Insects

Douglas-fir beetle	*Dendroctonus pseudotusugae* Hopkins	DF
Douglas-fir tussock moth	*Orygia pseudotsugata (*McDunnough*)*	DF, TF, ES
Gypsy moth	*Lymantria dispar (*Linaeus*)*	Most hardwoods
Mountain pine beetle	*Dendroctonus ponderosa* Hopkins	All pines
Pine engraver beetle	*Ips pini* (Say)	PP, LPP
Spruce beetle	*Dendroctonus rufipennis* Swaine	ES
Western balsam bark beetle	*Choristoneura occidentalis* Freeman	SAF
Western spruce budworm	*Dendroctonus brevicomis* LeConte	DF, TF, ES, WI
Western pine beetle	*Scolytis ventralis* LeConte	PP
Fir engraver beetle	*Pissodes terminalis* Hopping	GF, SAF
Lodgepole terminal weevil	*Adelges piceae* (Ratzeburg)	LPP
Balsam woolly adelgid	*Dsaychira plagiata*	SAF, GF
Pine tussock moth	*Neodiprion autumnalis*	PP
Sawflies	*Rhyacionia* species	PP

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LPP = Lodgepole pine; WWP = Western white pine; ES = Engelmann spruce; WH = Western hemlock; WL = Western larch; MH = Most hardwoods; WRC = Western redcedar; WBP = Whitebark pine

PUBLICATIONS

Anonymous. 1999. Douglas-fir beetle in the Intermountain West. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. Information brochure, R1-99-102.

Blocker, L.; Hagle, S.; Lasko, R.; Keane, R.; Bollenbacher, B.; Fox, B.; Samson, F.; Gay, R; and Manning, C. Understanding the connection between historic range of variation, current social values and developing desired conditions. *In*: Friedman, S.T.; Graham, R., compilers. Proceedings: National Silvicultural Workshop; 1999 October 5-7; Kalispell, MT. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

DeNitto, G. 1999. Medicine Tree, Confederated Tribes of Salish and Kootenai. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-9. May 18, 1999. 2p.

DeNitto, G. 1999. Evaluation of Dwarf Mistletoe Management on the Flathead Indian Reservation. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-20. August 12, 1999. 2p.

Gara, R.I.; Millegan, D.R.; Gibson, K.E. 1999. Integrated pest management of *Ips pini* (Coleoptera:Scolytidae) populations in south-eastern Montana. J. Applied Entomology 123:529-534.

Gibson, K.E. 1999 Managing stands to reduce DFB-caused mortality. Libby RD, Kootenai NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420.

FHP Trip Report 99-1. February 8, 1999. 4p.

Gibson, K.E. 1999. Douglas-fir beetle on Lolo National Forest. Status and Anticipated Trend. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-8. May 10, 1999. 7p.

Gibson, K. 1999. Douglas-fir beetle at Holland Lake Campground, Swan Lake RD. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-11. June 3, 1999. 7p.

Gibson, K. 1999. Mountain Pine Beetle Status and Management, Rocky Boy's and Fort Belknap Indian Reservations. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-12. July 9, 1999. 4p.

Gibson, K.E. 1999. Mountain pine beetle, Spotted Bear RD, Flathead NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-22. August 17, 1999. 2p.

Gibson, K.E. 1999. Windthrow and Mountain Pine Beetle, Butte RD, Beaverhead-Deerlodge NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-25. September 1, 1999. 3p.

Gibson, K.E. 1999. Douglas-fir Beetles on the Cabinet RD, Kootenai NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-26. September 8, 1999. 3p.

Gibson, K.E. 1999. Douglas-fir Beetles on the Fortine RD, Kootenai NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-27. September 13, 1999. 4p.

Gibson, K.E. 1999. Douglas-fir Beetles on the Hebgen Lake RD, Gallatin NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-28. September 13, 1999. 4p.

Gibson, K.E. 1999. Douglas-fir Beetles on the West Fork RD, Bitterroot NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-29. October 15, 1999. 5p.

Gibson, K.E. 1999. Mountain Pine Beetle on Butte Ranger District, Beaverhead-Deerlodge NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-31. October 28, 1999. 4p.

Gibson, K.; Lieser, E.; Ping, B. 1999. Bark beetle outbreaks following the Little Wolf fire, Tally Lake Ranger District, Flathead National Forest. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-7. 15p.

Hagle, S.K.; Taylor, J.E.; Schwandt, J.S.; and Bell-Randall, C. 2000. Functions of pathogens and insects in forest succession. In: Goheen, E.M., compiler. Proceedings: Western International Forest Disease Workshop; 1999 September 20-24; Brekenridge, CO. Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Washington Office.

Holsten, E.H.; Thier, R.W.; Munson, A.S.; Gibson, K.E. 1999. The spruce beetle. Forest Insect & Disease Leaflet 127. USDA Forest Service. 12p.

James, R.L. 1999. Evaluation of Nevada Divisison of Nursery, Las Vegas. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-13. July 9, 1999. 7p.

James, R.L. 1999. Ponderosa pine seed fungal contamination: effects of stratification and sterilizing treatments. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-3. 11p.

James, R.L.; Beall, K. 1999. An evaluation of the effects of dazomet on soil-borne diseases and conifer seedling production- USDA Forest Service Lucky Peak Nursery Boise, Idaho. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-9. 15p.

James, R.L.; Perez, R. 1999. Pathogenic characteristics of *Fusarium sporotrichiorides* isolated from inland Pacific Northwest forest nurseries. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-8. 11p.

James, R.L.; Perez, R. 1999. Fungal colonization of residual conifer seedling roots in soil-USDA Forest Service Lucky Peak Nursery Boise, Idaho. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-10. 13p.

Jewett, D.; Kegley, S. 1999. Douglas-fir beetle and underburning. Idaho Panhandle NFs, Sandpoint RD. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-6. April 19, 1999. 5p.

Jewitt, D.; Kegley, S. 1999. Kirby's Wildlife Habitat Improvement Project, Unit 11, Sandpoint RD, Idaho Panhandle NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-15. July 27, 1999. 4p.

Kegley, S.; Randall, C.; Jewett, D.; Wulff, D. 1999. Douglas-fir beetle population surveys, Idaho Panhandle National Forests, 1998. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-5. 5p.

Lockman, B. 1999. Evaluation of Insects and Diseases, Stand 1640803137, Ninemile RD. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-10. June 2, 1999. 4p.

Lockman, B. 1999. Elytroderma Needle Blight in Ponderosa Pine, Lick Creek, Darby RD, Bitterroot NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-24. August 20, 1999. 5p.

Lockman, B. 1999. Sawmill RNA, Bitterroot NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-23. August 20, 1999. 3p.

Lockman, B.L. 1999. Root disease conditions in Keystone Gulch, Superior RD, Lolo NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-32. November 3, 1999. 3p.

Lockman, B.; Gibson, K. 1999. Root Diseases and Bark Beetles in Pinkham Decision Area, Rexford RD, Kootenai NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-14. July 15, 1999. 5p.

Lockman, I.B.; Sturdevant, N.J. 1999. Three-year evaluation of effects of chlorine on Douglas-fir and ponderosa pine near Alberton, Montana. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-11. 7p.

McConnell, T. 1999. Montana Forest Insect and Disease Conditions and Program Highlights 1998. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. FHP Report 99-2. 39p.

Negron, J.F.; Shaupp, Jr., W.C.; Gibson, K.E.; Anhold, J.; Hansen, D.; Thier,R.; Mocettini, P. 1999. Estimating extent of mortality associated with the Douglas-fir beetle in the central and northern Rockies. J. Applied Forestry 14:121-127.

Randall, C. 1999. Douglas-fir beetle. Lakeface/Lamb project. Idaho Panhandle NFs, Priest Lake RD,. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-4. April 19, 1999. 18p.

Randall, C. 1999. MCH treatment at Mineral Ridge scenic area administered by BLM. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-7. April 19, 1999. 14p.

Randall, C. 1999. Lenore Tree Improvement Area and Weitas Campground Service Trip, Clearwater NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-17. August 10, 1999. 9p.

Randall, C. 1999. Coeur d'Alene Mountain Service Trip, Coeur d'Alene RD, Idaho Panhandle NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-19. August 11, 1999. 3p.

Randall, C. 1999. Mutch Creek Marsh Service Trip, Idaho Department of Lands. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-18. August 11, 1999. 2p.

Randall, C.; Barbouletos, T. 1999. Yellow Toadflax Biological Control, Hebgen Lake RD, Gallatin NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-16. August 10, 1999. 4p.

Randall, C.; Byler, J.; Hagle, S. 1999. Commercial thinning in Douglas-fir and cedar decline. Clearwater NF, Lochsa/Pierce RDs. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-2. April 19, 1999. 5p.

Randall, C.; Kegley, S. 1999. Douglas-fir beetle. English Point recreation area. Idaho Panhandle NFs, Coeur d'Alene River RD, . Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-5. April 19, 1999. 6p.

Taylor, J.E. 1999. Evaluation of Potential Dwarf Mistletoe Suppression Project Area, Pryor Mountains, Crow Indian Reservation. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-21. August 17, 1999. 2p.

Taylor, J.E. 1999. Insect and disease evaluation of Cooney Brothers' Ranch. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-33. November 3, 1999. 2p.

Taylor, J.E. 1999. Insect and disease evaluations of campgrounds, East-side of Glacier National Park. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-35. December 6, 1999. 4p.

Taylor, J.E.; Gibson, K.E. 1999. Insect and Pathogen Evaluations of Developed Sites in Glacier National Park. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-30. September 13, 1999. 18p.

Taylor, J.E.; Gibson, K.E. 1999. Insect and disease concerns in Holland Lake Campground, Flathead NF. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-34. November 4, 1999. 2p.

Wulff, D.; Gibson, K. 1999. Douglas-fir beetle. Nez Perce NF, Moose Creek/Red River RDs. Missoula, MT: USDA Forest Service, Cooperative Forestry and Forest Health Protection. File 3420. FHP Trip Report 99-3. April 19, 1999. 5p.